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ABSTRACT

Prepared to introduce the user to advanced scientific and technical information services and systems (STI/SS), this guide emphasizes computer searches, helping the user to set the bounds of his or her problem, to define the way the literature is stored in the computer, and to develop an improved problem statement with which to enter the computer. Chapters explain defining the scope of a search, browsing, manual searching, the operation of an online system, interpreting system output, selecting relevant information from retrieved abstracts, accessing hard copy and full texts, and current developments in STI/SS. Sample searches, user profile forms, descriptions of manual indexes and online databases, and the elements of a complete record are included. (FM)

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COMPUTERIZED INFORMATION RETRIEVAL
A USER GUIDE

U S DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

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TABLE OF CONTENTS

Acknowledgements i

1. WELCOME TO THE WORLD OF INFORMATION 1

2. GETTING STARTED 6
   A ..with a well-define idea 6
   B...with a manual search 11
   C...by browsing 13

3. COMPUTER SERVICES 15
   A...why a computer search 15
   B...how the computer system operates 16
   C...what comes out and how to interpret it 20
   D...sample searches 23

4. AFTER THE ABSTRACTS, WHAT NEXT? 36
   A...what to select 36
   B...how to access it 37

5. SOME FUTURES 39

Appendices 45
   A. User Profile 45
   B. Manual Indices 49
   C. Computerized Data Bases 51
   D. Elements of the Complete Record 57

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Section 1

WELCOME TO THE WORLD OF INFORMATION

Information is exploding! Its impact is enormous! To give you some idea of the magnitude of this explosion, consider the following data* regarding trends in science and technology publications:

Journals. From 1960 to 1974, the number of U.S. scientific and technological journals increased from 6300 to 8400. By 1980, an estimated 9400 will be published.

Articles. In 1960, 211,000 were published; in 1974, 304,000. By 1980 the estimate is for 350,000.

Patents. Approximately 108,000 patent applications were filed in 1974, compared with 85,000 in 1960; projections for 1980 are suggesting 123,000. Of these, 50,000 patents were granted in 1960; 85,000 in 1974; 98,000 are projected for 1980.

Technical Reports. In 1965, 14,000 reports were processed by the National Technical Information Service of the U.S. Department of Commerce. By 1974, this number had grown to 61,000. 85,000 are expected by 1980.

Dissertations. Increase here is also significant -- from 3800 in 1960 to 9500 in 1974.

Books. In the science and technology sector, 3,400 books were published in 1960; 14,500 in 1974. By 1980, a total of 17,000 titles is anticipated.

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*King, D. W., et al, "Statistical Indicators of Scientific and Technical Communication 1960-1980, "Vol.1, A Summary Report, National Science Foundation

The above data do not include worldwide publication of science and technology literature. Indeed, the United States contributes only 33% (roughly) of this total output. As you can see, there is a wealth of information out there.

Now, place your own research problem in this context. You want to be sure that you are not "re-inventing the wheel." You believe that your work has not been done before and that its solution will advance the state-of-the-art. Thus, there is a need to search this vast literature. Within the framework of the data cited above, this is a formidable problem.

The purpose of this User Guide is to introduce you to advanced scientific and technical information services and systems (STI/SS). Over the last several years, such systems have become computer-based. As we will see later, they are particularly useful for several types of problems: multi-faceted questions, in-depth retrospective reviews, first appearance of new ideas, and convenient up-dates.

Before jumping into this world, it might be useful to take a moment to discuss why and when we search. To do this, we look at the various phases of research and the impact that information can have on these phases. We refer you to Figure 1-1 which pictorially displays the innovation process and its stages; your problem may be located at any of these steps.*

In the discovery and invention phase, we may be uncovering new basic principles. A search here can assure us that our ideas are, in fact, new, that they do not violate basic physics, thermodynamics, etc. During the innovation stage we take established data, laws of mechanics, etc. and apply them to new situations. Thus, in searching the literature, we seek to uncover confirming experimental data, analogous situations, and theoretical analyses which all bear on our topic.

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*Recent studies have addressed the relationship of information access and strategy to research tasks; see for example, Allen, T. J., "Managing the Flow of Technology," MIT Press, Cambridge, Mass., 1977.

The diffusion phase, on the other hand, has us looking, for example, at a new product and trying to establish market trends, production techniques, demographic data, etc. in order to understand the costs of producing the product and the degree to which it might be used. All these kinds of knowledge -- and more -- can be acquired from effective searches.

While we will emphasize computer searches (advanced STI/SS) -- and they will become increasingly commonplace over the years -- the importance of a good preliminary manual search should not be underestimated. It sets the bounds of your problem; it helps you define the way the literature is stored in the computer; it can develop an improved problem statement with which to enter the computer.

To use the computer, we suggest that you work with professionally trained intermediaries to gain easy access to the system and to help in search strategy. Since many of the advanced STI/SS are rather unforgiving,* as presently set up, you can guarantee an effective search with the aid of reference librarians; you and the intermediary have complementary roles. The latter has detailed knowledge of the computer language and the data bases** and you have a grasp of the problem to be searched. Working together, effective approaches to the literature can be made.

To do this, you will need to know yourself and your problem well (see Section 2); you will need to understand how the STI/SS works and what it can do for you (see Sections 3 and 4). Our goal here is to introduce you to these systems so that they, like so many other tools, become part of the equipment you acquire in your education.

It should be recognized that the bibliographic files we address here are not the sum total of advanced STI/SS. Indeed, as your re-

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*In time, these may change and you, the user, may have direct access.

**Data bases are defined later; here, simply take them to mean the collection of literature stored in the computer.

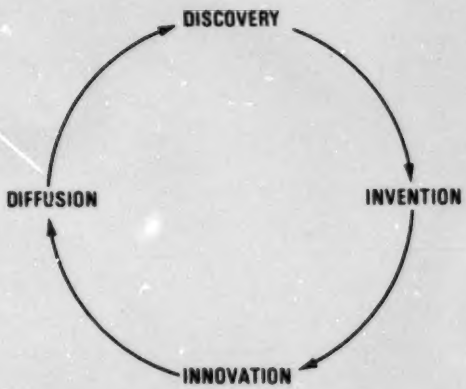

FIGURE 1-1 THE PHASES OF RESEARCH

search sophistication grows, you will begin to ask questions like: "Isn't all that data collected in a single place for me?", "Hasn't someone put these demographic projections together already?", etc. We look at futures in Section 5 and suggest where the world of information might be going. This short precis might raise your level of awareness and when these projected bases become available, you can access them as well.

Section 2

GETTING STARTED

Now that you've learned something about the growth of information in our society, and been introduced to advanced systems, we turn to their use and access in your particular research project. Note that we are going to assume that you already have some well-defined ideas which you want to explore and that, at least in title, your research is well formulated.

Later in this chapter we will cover an area important to all research: browsing. Indeed, if your project is not at least in the title stage, but at the rather ill-defined "something in..." stage, you should jump to the end of this section and to the next section to see how the literature can be used to help formulate a problem statement. Later, of course, you will want to return to the items below.

A....with a well-defined idea

As you might imagine, there are all sorts of ways to find out what is happening in your field of interest. Many of these are displayed in Figure 2-1. Some of the methods are formal, some informal; some effective and some not so effective. The value judgments you make along the way with regard to quality will improve as both your research capability and your searching techniques get better.

While the focus of this guide is primarily library sources -- through your own initiative, or with the aid of computerized data bases -- some comments are in order with regard to the more informal literature sources. As you will find over the years, colleagues are generally good (albeit limited) sources of information. Among other

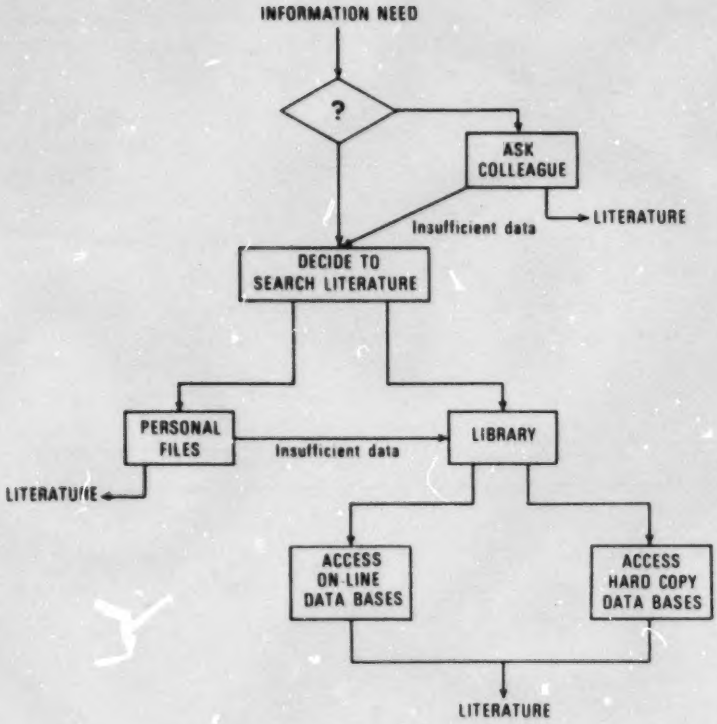

FIGURE 2-1 POSSIBLE PATHS TO A LITERATURE SEARCH

things, they can often point out some of the documentation available and help you to formulate (or reformulate, if necessary) your research problem.

In the future, as your research and project experience grows, so will your personal library. Now, as a student, it predominantly consists of textbooks. Later, you will be adding current monographs in specific narrow areas and journals from a number of professional societies. Thus, your own files will always be an important source of data and should not be overlooked.

Once you have established your research interests and have built a personal library relevant to those needs, your new undertakings will generally be changes or advances in your basic area of specialization. Again, your own library will be an excellent resource.

Now, however, let's focus on library resources currently available to you. But before we can jump into these, you will need to know more about yourself and your topic. For this purpose, a profile of your information needs is most helpful. A supply of data forms has been appended to this guide (see Appendix A) with which you should become familiar. These have been designed to assist you in whichever of the library paths* in Figure 2-1 you use to approach the literature. It is essential that you look these over now before you go on.

Most of the questions in the profile are self-explanatory, but it might be worthwhile to review them. The structure and ordering of the questions play an important role in defining your needs and are pertinent for either of the approaches.

Questions 1 and 2 really force you to define your problem by giving it a title and defining it in the narrative. In the latter, you

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*Note that while this is geared to computerized searches, it is extremely useful in performing manual searches.

should be as specific as possible, and use scientific and technical terms in addition to more common vocabulary. Here, it is important to indicate the expected results of your research -- applications, end uses, theoretical solutions to a scientific problem (you may be looking for experimental data to verify your newly derived theory), experimental designs for complex physical situations, marketing data.

Note that in Question 2 you are asked to underline and thereby highlight those words, phrases or key elements essential to your research. As we will see later, these highlights will help to define the literature search. Furthermore, you should pay particular attention to newly coined or newly defined words. As science advances, words and phrases take on new and different meanings so that their context within a search must be carefully evaluated.

Question 3 asks for some of the information you obtained in your manual search. Naturally, if you are using this profile to help you to initiate a manual search, this question can be skipped. On the other hand, if you have completed that phase (see below), then you should be able to list several useful key words and complete citations which will be an asset in accessing the literature in the on-line, computerized data bases.

Different forms of publications vary in the kinds of information they contain. Question 4 gives you an opportunity to limit the kinds of publications covered in your search and to indicate those of special importance. For example, a search for information on the constitution of a chemical compound might rely heavily on patents; while a search for its toxicity would not. If you are searching for broad surveys, rather than detailed examination of a particular aspect, you would probably want to exclude dissertations but include reviews.

The next set of questions (5 through 7) help to further refine your search process. Question 5 addresses the issue of topics of no interest to you. As noted on the questionnaire, these exclusions may

arise because you are not interested in a particular approach to the literature or are fully aware of such an approach and do not need it.

Questions 6 and 7 are related and identify the most important authors, organizations, and journals. You should indicate if you wish to exclude documents from any of these due to prior familiarity; e.g., Author X shares your office or you have a subscription to a journal, or because you are not concerned with the type of material they offer (too theoretical or too practical, etc.). The reason for developing these lists become clearer when we actually sit down to do the search. However, these authors, journals, etc. give us important clues to how the literature in a field of interest is stored.

Question 8 is self-explanatory.

Question 9 focuses on an important aspect of literature searches. Is the research a new venture for you and your study team? Are you simply checking the literature for up-dates to your on-going work? In the former case, you are looking for as much material as you can find -- an in-depth, retrospective search. This will afford you the opportunity to note the historical development in an area, the varying theoretical or experimental approaches, the changing market environments, whether or not your particular problem has been worked on before, etc. The up-dates provide you with a current awareness of new developments made since your last search was done. Further, these should be undertaken as your new research progresses to be sure that some new contribution can or cannot be applied to improve or substantiate your own study.

Naturally, there is a limit to the number of abstracts and citations you can absorb. Question 10 addresses this point. Since data within the data bases is stored in reverse chronological order (latest first), cutting off the literature eliminates only the older literature.

Before answering Question 11, you might find it profitable to turn to Appendices B and C to see the types and sources of information bases available. In the former, hard copy documents (discussed below) are offered, and in the latter, computerized data bases are displayed. These are discussed in Section 3. After you have become more familiar with these sources, it will be easier and more beneficial to complete Question 11.

B....with a manual search

Manual searches, without sophisticated hardware assistance, are what you have probably been doing for years. In large measure, these have been successful and you have usually uncovered sufficient literature and material for term papers, reports, etc. Here, we are simply going to formalize this process for more advanced research.

We would strongly recommend, that, as a rule, you do a brief manual search before using the advanced computerized systems and services. This will help you to complete the profile, give you information leading to an effective focus for your computer search, provide first links to the literature, and offer important clues for determining how that literature is stored in the machine. Note that what we are actually saying is that a manual search can uncover the same literature retrieved by the computer (albeit more slowly).

To fully understand the development of a manual search, it is important to look first at the indices and abstracts of periodicals. In Appendix B, a reasonably complete list of these hard-copy volumes is presented, along with a description of their contents. Specialized indices are also noted; these deal with very specific topics and generally cut across the boundaries of other indices.

These volumes are guides to information published in the major journals. Periodical indices and abstracts are similar, yet different. A periodical index only indicates "WHERE" you can locate information on a particular subject. A periodical abstract, on the other hand,

not only indicates "WHAT" has been published and in "WHICH" periodical, but also provides a short and concise summary of the contents of the article. By their very nature, periodical abstracts are primarily concerned with research and technical literature. Because of the peculiar nature of this literature, it is often just as important to have a summary of the literature as it is to locate it.

In order to show an example, we will concentrate on the Engineering Index. Since this publication not only indexes the literature, but offers abstracts as well, you will find such abstracts classified under main subject headings and subheadings. "MAIN SUBJECT HEADINGS" are printed in boldface capital letters, while the "Subheadings" are printed in boldface capital and small letters. Specific subjects are used wherever possible.

But how do you use the Engineering Index to find information desired or needed? To find an item or "information," search the index for those terms which describe the area of specific interest. Suppose your research was related to "Electrostatic Precipitators in Air Pollution," an examination of Engineering Index would reveal several possible approaches to the literature. Looking in the index under "ELECTROSTATICS" you might find several references to that topic, but none that specifically refer to your subject. Using the term "PRECIPITATORS" would probably produce similar negative results but still must be checked. More than likely, you would find that the most productive subject term would be "AIR POLLUTION." Normally, this subject term will provide references to many articles on Air Pollution. It is up to you to examine the listings to discover which ones meet your specific needs.

Now that you have located the subject terms(s) in the index which refer to what you need, how do you get the information? Remember that indices are only a guide to the literature; now you want the literature itself. Using the abstract entry in Engineering Index, under the subject term, "AIR POLLUTION," you might find an article entitled, "De-

sign of a 35,000 kW High Carbon Ferrochrome Furnace Equipped with an Electrostatic Precipitator." The article written by J. W. Scott appeared in the Electronic Furnace Proceedings, Metallurgical Society of A.I.M.E., Iron and Steel Division, Vol. 29, Dec. 8-10, 1971, pp. 80-82.

As you do your literature search, some kind of file system to note the articles you locate is helpful and can be used again when you locate all of the references you wish to use; later you can decide which ones to read. Once you have listed all the entries -- or references -- you can begin to look for the journals and other sources in the library. You will then know exactly which issue of a journal you want and the librarians can help you to locate this hard copy (of which more in Section 4).

In searching the literature you must also note the "see" and "see also" references that are printed after the main subject headings and/or subheadings. These act as guides to other subjects which should be checked for items of related information.

Finally, when doing a literature search, be thorough. Start with the latest issues or volumes and continue backward into each preceding year's issues or volumes. A search must be as retrospective as possible and/or necessary to permit you to discover whatever information is available on a particular subject.

C....by browsing

Most of us have browsed in bookstores and libraries to see what attracts us. Here, we want to extend the concept of browsing to scientific and technical information services and systems. For our purposes, let's assume (as noted earlier) that you are interested in a vast field (something in...) but want to focus attention on a particular aspect that appears attractive.

Now, of course, your reasons for reviewing the literature are no longer the same. After completing the form in Appendix A, you realize

now that your purpose for a search is dramatically different. Even though your background and level of awareness of a specific need or study area are still general and ill defined, a careful review of the available literature can and will help you to focus.

One way might be to define the subject of your search in broader terms than those suggested in Section 2-A, but to limit it to reviews and monographs, or perhaps journal articles of recent vintage which will give you an overview without an unmanageable number of citations.

For example, many researchers develop review papers in their field of interest which highlight, among other things, the state-of-the-art. Thus, you can begin to look at unsolved problems to see if any is relevant to your needs. Design requirements and specifications in a particular field are important; this browsing mode can help you find them.

Furthermore, manual searches, with regard to helping you focus, takes on an important meaning in this context. It can lead you, even with a general search, to such articles as described above. In turn, they can give you a beginning awareness of the nature of your field of interest.

Finally, browsing can help you find material serendipitously and can generate an awareness and interest in new and emerging fields.

Section 3

COMPUTER SERVICES

You are now at the stage where you are ready to perform a computer search -- you have completed the questionnaire along the lines suggested in Section 2 of this guide, and have done a preliminary manual search. In this discussion of computer searches we will be looking into several distinct phases of the problem, such as:

- why a computer search at all
- how the computer searches its data bases and how they develop
- what comes out -- format, recall, relevance

In addition, some examples of computerized searches will be displayed so you can see exactly how the operation proceeds.

A....why a computer search

Computer searching is particularly useful for several types of problems. First, consider the case where the problem is multifaceted and requires coordination of concepts. The combination of several large "families" of ideas, each involving related concepts, can result in a search requiring an awareness of ten to twenty key items. The mind cannot reasonably hold all these ideas, much less manipulate them logically for a manual search. The computer can.

Specifically, imagine that you are interested in material related to electrostatic precipitators in air pollution (the same topic as for our manual search in Section 2). There are three major "families" of ideas: Electrostatics, Precipitators, Air Pollution. Within these, we can easily identify many related concepts -- air pollution involves automobile exhausts, industrial operations, incinerators, etc. This multiple combination of ideas makes it formidable for manual search methods.

Another instance where computers can make a significant difference is in an in-depth retrospective review of the literature. Here, the problem is searching a vast volume of data (possibly tens of thousands of items) for relevant material. In this case, even a single "family" search (Windmill Applications, as an example) would be a prodigious effort if done manually. However, here, the computer can act with its "super-clerk" capacity, rather than with its logical ability.

Finally, the computer may be used for "text searching" if the data base permits. If available, this capability allows you to search titles and abstracts for a word or phrase to locate subjects or points of view which are not included in the computer index. (Their exclusion might be attributed to their being too new or that a particular item of concern is not covered in the index.) Thus, you can more easily determine coincidence of concepts, find out when an idea began to appear in the literature, see statistical configurations of knowledge, etc. Because the computer provides the capability to do highly complex searches based on massive quantities of data, the machine search will promote extraction of new patterns of information, in addition to being a quicker way of doing old things.

B....how the computer system operates

Fundamentally, an information data base is the set of literature that has been produced by researchers in a given field within certain parameters of scope, discipline, subject and time. In Appendix C, some of these parameters are identified for a variety of bases. This literature is abstracted, its key elements noted, and then entered into the data base. For an idea of the flow of information through the system, look at Fig. 3-1. In a sense, your needs will be provided by the data base, translated into a technical report of some kind as a result of your research, transmitted to a data base, and ultimately be available for others to access, use and further advance the state-of-the-art.

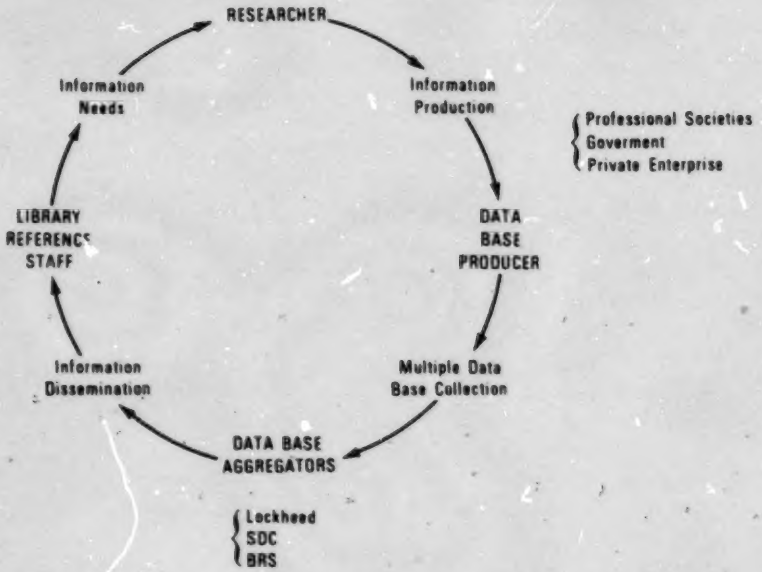

FIGURE 3-1 THE SEARCH/SERVICES INFORMATION SPECTRUM

To better appreciate how the computer performs a search and utilizes the data bases, let's return to the multifaceted search suggested earlier: "Electrostatic Precipitators in Air Pollution." Generally, the strategy employed is based on a combination of set theory and Boolean logic. For our example, let

Set A = the citations within the data base referring to Air Pollution

Set B = those citations referring to Electrostatics

Set C = those citations referring to Precipitators

In Fig. 3-2, a Venn diagram indicating these sets and their overlap is displayed.

The areas of overlap -- D, E, F, G -- represent those documents described by two or more of our large "families" of ideas. In phrasing your request to locate the relevant items, there are many possibilities. You might be interested in those documents described by both "Air Pollution" and "Electrostatics" which are those in D and G, or you might ask for those described by "Air Pollution" and either "Electrostatics" or "Precipitators" which are in areas D, F, and G. If you decide to narrow your request and seek information on "Air Pollution" and Precipitators only, this would lead to F, only. Finally, a search which is restricted to documents described by all three leads to G only.

These combination are based on the Boolean logic operators, AND, OR, NOT:

AND indicates things common to two or more groups

OR indicates things in two or more groups, whether in common or not

NOT indicates things not in a particular group or groups

When the search is performed, you generally define all the materials included in each of these circles or sets. An example might help. There are many building blocks to consider under the general title, "Air Pollution." We have to account for thermal pollution,

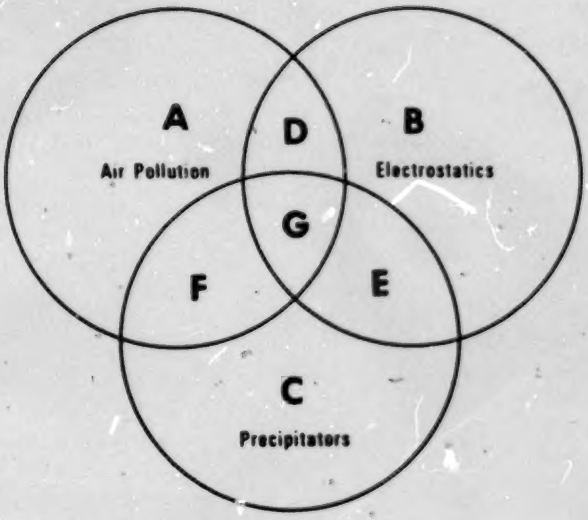

FIGURE 3-2 VENN DIAGRAM FOR MODEL SEARCH

automobile exhaust, incinerator exhaust, power plant effluents, etc. Within a data base all of these items may be included and subsumed with the term, "Air Pollution." The computer can sort through its entire data base (which can include topics from aerodynamics to zoology) and select those with the desired descriptors belonging to Set A. It does the same for Sets B and C.

Note that if you are interested in only one type of "Air Pollution," you can further delimit the computer sort in establishing Set A. Finally, and according to the Boolean logic operators, the computer sorts your information requirements and yields the combination sets, D, E, F, and/or G.

Before proceeding to the output, this brief paragraph about the elements used to describe the various documents in a data base might be in order. Most of the data bases use four basic elements as search access points: Author, Institution, Descriptor and Identifier. Author is obvious and needs no further amplification. Institutional designations are useful when an organization is known to be engaged in a pertinent area. Descriptors are the controlled vocabulary of a data base and authoritative lists of appropriate descriptors are available in a thesaurus for each of the data bases listed in the Appendix. In general, a descriptor is the subject heading, key word or index term. Identifiers are not usually in the thesaurus but permit a narrowing down of your key concepts. These might be names, proper nouns, or newly defined ideas. It might be useful to review your profile now with these thoughts in mind.

C....what comes out and how to interpret it

In this section we look at output and its related problems. This leads naturally to the examples in the following sub-section.

1. Output Formats. First, let's consider the mechanics of the computer operation. While there are some variations between the data bases, the same general formats are available and all are useful at different times and under different circumstances.

a) Accession Number Only -- If the library has the hard copy versions of the data base files, the user may find it convenient to simply walk away with a list of accession numbers, (see Section 2) and gather the abstracts manually.

b) Title Only -- This is a convenient tool as the search progresses and permits the user assurance that truly relevant material is being selected.

c) Full Record -- Generally, we can obtain the above information on-line, plus author, organization, contract number (if if sponsored), sponsoring agency, abstracts, identifiers, and descriptors. This format is useful in two ways. During the search phase one or two may be investigated for hints to other key words; in the final stage, some abstracts may be obtained on-line which provide you with working material while waiting for the rest to be printed off-line; this is usually delivered to the library within 3 to 5 working days after requested. (To receive the complete article, "hard copy" must be accessed; this is discussed in Section 4.)

2. Volume of Output. The number of citations received in response to your search can vary from zero to many thousands; you can alter the organization of your search to retrieve more or less output, if desired. Normally, you are interested in some background and selected material providing data and information for your research.

It should be recognized that as volume mounts, it approaches a point where it will exceed your ability to encompass it, comprehend it, make good use of it, or even read the titles. Most data bases are stored with the most recent literature first so that cutting off will eliminate the older literature. Alternatively, it might be better to narrow the subject scope of your search by adding another term to the profile so you will be able to retrieve both older and newer documents more narrowly limited to the subject of your research.

If you get zero output in a few cases, it might verify what you are hoping is true. For example, that no one else is working on your particular topic and that it has not been done before. Normally though, you expect to receive some information. The following checklist might be helpful if you do not receive the output you expect:

- Was the search coded correctly for the computer?
- Were there typographical errors?
- Was your Boolean logic too restrictive?
- Can you look at known documents for clues?
- Is the material you are seeking in the data base searched?

3. Quality of Output. Now, let's assume that you have your abstracts. How profitable was your search? This may not be directly measurable but we can look at two related factors that can assist you in evaluating the output:

> Relevance (or Usefulness) - this is a measure by you or a panel of judges as to the relevance of the items received by you in terms of your original search request. Numerically, we define "relevance" as the ratio of the number of relevant references retrieved to the total number of references retrieved.
>
> Recall - this is a measure of how many of the relevant items in the file were found. (It is calculated by the ratio of the number of relevant references retrieved to the number of relevant references in the file.) Note that this requires advanced knowledge of the actual structure of the data base and so has limited utility.

Both of these measures are more qualitative than quantitative; suggestive rather than definitive. The basic question becomes: do you want what you have? In a search you should indicate whether or not you wish to emphasize high relevance or high recall. In the former, usually calling for "AND"-ing more terms, you lose the opportunity to make unexpected valuable finds among material only partially related to your topic. Striving for high recall, by decreasing the number of "AND"-ing terms and/or adding more "OR"'s, might bring a heavy proportion of marginal material and a large volume of data.

The present state of the art does not permit us to make absolute evaluations of quality. There are some general guidelines which might help you decide if your results are as good as can be expected.

Of the total documents retrieved, what proportion are actually useful to your needs? No system can give you all the useful documents while leaving out those not useful for your search. If somewhere between one third and two thirds of your documents are useful (relevant) you have probably done pretty well. If a lower proportion is relevant, you might be content, if you are really looking for just a few very useful documents. If, on the other hand, you want to be sure that you come as close as possible to retrieving every document in the system on your topic, you should be happier with output which contains, intermixed with a large number of useful documents, quite a few less useful or useless ones. In the first case, you have hopefully used a very narrow search formulation, and in the latter, a broad one to get the general kind of results you desire.

Determining precisely how much of the useful material actually in the system was retrieved is impossible without examining every document in the system. In general, you should consider whether there are any documents you know of that you expected to retrieve and didn't, and whether the total useful output seems reasonable in quantity. Your judgment here will be based largely on your knowledge of the literature based on use of manual sources and will improve as your research capability grows.

D....sample searches

In this section we offer four simple and rather basic searches and strategies. We do this to show that simple techniques can lead to useful retrieval, relevant information and approaches to more complete and sophisticated techniques by carefully reading abstracts. We will

be using examples from the major data base suppliers. Among other things you will observe what, at first glance, appears to be markedly different output formats. A study of them, however, will show that they are indeed quite similar in context.

In looking at the selected abstracts, you will observe that some offer very useful data. This point cannot be overemphasized. In writing any report, especially in today's information environment where access is through the computer, abstract writing becomes a crucial ingredient for getting meanings, results and conclusions to potential readers..

1. Browsing. Assume that you are interested in some aspect of engineering education but are not sure how such information is stored in the relevant data base (in this case, ERIC*). We enter the ERIC and ask it to investigate the term, Engineer, (see Fig. 3-3a). Note that in the display, the computer actually "backs up" alphabetically so that you can also see terms spelled nearly the same. Our key term appears on E6.**

We ask the computer for more and at E22 we note "Engineering Education. The number immediately following indicates the total number of records under that descriptor (1182); there are also seven related terms. Next, we investigate the related terms (see Fig.3-3b) to see if any of those might attract our attention.

While investigating the related terms, let's assume that "Engineering Technology" (R4) is the aspect of engineering education that is of most interest. The computer is then directed to select it (SR4). The next line indicates how many records are listed under this descriptor. Finally, we ask the computer to type the first two. The

---

*Educational Resources Information Center

**Also note that misspellings in descriptors get carried along (see Term E5).

```
          File01:ERIC FULL TEXT JAN77
          Set Items Description (+-OR;*-AND;--NOT)
          --- ----- -----------------------------

? EENGINEER
Ref   Index-term                Type Items RT
E1    ENGINE DEVELOPMENT
        TECHNICIANS-----------           1
E2    ENGINE DIAGNOSTIC CENTER           1
E3    ENGINE DYNAMOMETERS-----           1
E4    ENGINE MODIFICATION-----           1
E5    ENGINEEERING------------           1
E6    -ENGINEER---------------         212
E7    ENGINEER'S--------------          19
E8    ENGINEERED--------------          47
E9    ENGINEERED CLASSROOM----           2
E10   ENGINEERED CLASSROOMS---           1
E11   ENGINEERING------------        3505 15
E12   ENGINEERING AID---------           1
E13   ENGINEERING COLLEGE ADMI
        NISTRATION COUNCIL----           1
E14   ENGINEERING COLLEGE
        RESEARCH COUNCIL------           2
E15   ENGINEERING CONCEPTS
        CURRICULUM PROGRAM----           1
                                       -more-
? P
Ref   Index-term                Type Items RT
E16   ENGINEERING CONCEPTS
        CURRICULUM PROJECT----          11
E17   ENGINEERING COUNCIL OF
        PURDUE UNIVERSITY (---           1
E18   ENGINEERING COUNCIL ON
        PROFESSIONAL DEVELO---           1
E19   ENGINEERING DATA AND
        INFORMATION SYSTEM----           1
E20   ENGINEERING DESIGN
        EDUCATION-------------           1
E21   ENGINEERING DRAWING-----          26  4
E22   ENGINEERING EDUCATION---        1192  7
E23   ENGINEERING EXECUTIVE
        PROGRAM---------------           1
E24   ENGINEERING GRAPHICS----          26  5
E25   ENGINEERING INDEX-------           1
E26   ENGINEERING INDUSTRIAL
        TRAINING BOARD--------           2
E27   ENGINEERING INDUSTRY----           1
                                       -more-
```

Figure 3-3a. Sample Search 1 -- Browsing with a Descriptor

```
? EE22
Ref  Index-term                Type Items RT
R1  -ENGINEERING EDUCATION---    1192  7
R2   PROFESSIONAL EDUCATION--P   1713 27
R3   AEROSPACE EDUCATION-----R    2?? 12
R4   ENGINEERING TECHNOLOGY--R    173  5
R5   LAND GRANT UNIVERSITIES-R    116 10
R6   SCIENCE EDUCATION-------R   9071 21
R7   TECHNICAL EDUCATION-----R   2512 36
R8   VOCATIONAL EDUCATION----R   7369 43
?


  SR4
          1    173 ENGINEERING TECHNOLOGY
? T1/5/1-2
1
EJ140231  SE516932
  The Role of Special Interest Courses
  Smith, Kenneth    Engineering Education; 66; 8; 815-817    May 76
  Descriptors:    *Engineers/  *Engineering  Education/  *Inservice
Education/  *Program  Development/  *Short  Courses/  Curriculum/
Engineering/  Engineering Technology/ Higher Education/ Technical
Education
  Discusses the key aspects of developing special-interest, non-credit
short  courses  directed  specifically  to  those already employed in a
particular field of engineering or engineering technology. (MLH)

2
EJ140230  SE516931
  A Survey of Faculty Qualifications
  Hart, E. Franklin; O'Hara, James S.    Engineering Education; 66; 8;
812-814    May 76
  Descriptors:  *College  Faculty/  *Engineering  Technology/  *Faculty
Promotion/  *Higher  Education/ *School Surveys/ Engineering Education/
Faculty Evaluation/ Surveys/ Teacher Characteristics
  Describes  a  survey  of  30  institutions  that offer baccalaureate
degrees in engineering technology; reports on the hiring and promotion
policies for the engineering technology faculty at these institutions.
(MLH)
```

Figure 3-3b. Sample Search 1 -- Browsing with a Descriptor (Concluded)

interpretation of the various lines of typical abstracts is offered in Appendix D.

2. Known Author. Now let us look at a different type of search. Here we are interested in Biofeedback and we will make use of the Psychological Abstracts data base. To obtain some feeling for how the literature may be stored in this base, we make use of another piece of information. One of our colleagues has advised us that Dr. Maurice Small has published a review in this field.

We enter the appropriate data base and search for the author's name: first, on "Small, M." then on "Small,Maurice" (see Fig. 3-4a). The "ADJ" means that the initial, M, or the name, Maurice, should be adjacent to Small. We observe that after combining these two, there are six items. We ask the computer to then list their titles. Item 1 is clearly the citation we seek. Its complete record follows (Fig. 3-4b), and we learn additional subject terms, e.g., Behavior Theory, to supplement our search on Biofeedback.

3. General Search. In this example we are looking for literature dealing with energy conversion using the wind as the power source (Windmills). An appropriate data base might be NTIS*. The search strategy is displayed in Fig. 3-5a. We select the following terms: Wind, Winds, Windmills, Energy Conversion. Notice that we are dealing with a great mass of data -- over 10,000 abstracts.

We now want to narrow the search. By the proper use of the Boolean operators, we combine the four terms and come up with a manageable number (15)**.

---

*National Technical Information Service

**Consider the manual effort involved to reach such a manageable number.

```
R0102 ENTER DATA BASE NAME_:   PSYC

/SIGN-ON   17.26.52                    04/25/77:

R0201 ENTER COMMAND:
   ..SEARCH

BRS - SEARCH MODE  - ENTER QUERY
00001_:   SMALL ADJ M

    RESULT          1
00002_:   SMALL ADJ MAURICE

    RESULT          5
00003_:   1 OR 2

    RESULT          6
00004_:   ..PRINT

BRS - PRINT MODE - SPECIFY PARAGRAPHS
   TI

R0521 # SPECIFY DOCUMENTS
   DOC=1,6
                1
TI      CLINICAL APPLICATIONS OF BIOFEEDBACK TECHNOLOGY: A REVIEW OF THE
        LITERATURE AND FIVE CASE HISTORIES.

                2
TI      TREATMENT OF STUTTERING: A CASE HISTORY.

                3
TI      EEG ALPHA AND HYPNOTIC SUSCEPTIBILITY.

                4
TI      MODIFICATION OF PERFORMANCE ON THE ROD-AND-FRAME TEST.

                5
TI      SPEECH-ENVELOPE CUES AS AN ACOUSTIC AID TO LIPREADING FOR PROFOUNDLY
        DEAF CHILDREN.

                6
TI      HYPNOTIC SUSCEPTIBILITY AS A FUNCTION OF THE PRESTIGE OF THE
        HYPNOTIST.
```

(CONTINUED NEXT PAGE)

Figure 3-4a. Sample Search 2 -- Searching with an Author's Name

```
R0601 * END OF DOCUMENTS IN LIST - ENTER RETURN OR ANOTHER COMMAND.

   ..PRINT

BRS PRINT MODE -- SPECIFY PARAGRAPHS_:   ALL

R0521 * SPECIFY DOCUMENTS
   DOC=1
                  1
AN        10352 56-6.
AU        SMALL, MAURICE M.  HULL, ETHEL I.
IN        NEW HAMPSHIRE HOSP, CONCORD.
TI        CLINICAL APPLICATIONS OF BIOFEEDBACK TECHNOLOGY: A REVIEW OF THE
          LITERATURE AND FIVE CASE HISTORIES.
SO        CATALOG OF SELECTED DOCUMENTS IN PSYCHOLOGY. FAL 75 VOL 5 337.
LG        EN.
YR        75.
CC        3330.
PT        10.
DE        BIOFEEDBACK LITERATURE-REVIEW CASE-REPORT BEHAVIOR-THERAPY.
ID        CLINICAL APPLICATIONS OF BIOFEEDBACK TECHNOLOGY, REVIEW OF LITERATURE
          & CASE HISTORIES.

              END OF DOCUMENT
```

Figure 3-4b. Sample Search 2 -- Searching with an Author's Name (concluded)

```
?FILE NTIS

PROG:
ELAPSED TIME ON ORBIT: 0.00 HRS.
YOU ARE NOW CONNECTED TO THE NTIS DATABASE.

SS 1 /C?
USER:
WIND

PROG:
SS 1 PSTG (8858)

SS 2 /C?
USER:
WINDS

PROG:
SS 2 PSTG (229)

SS 3 /C?
USER:
WINDMILL?

PROG:
MM (WINDMILL?) (2)
                1  WINDMILL (IT)
                2  WINDMILLS (IT)
SPECIFY NUMBERS, ALL, OR, NONE-

USER:
ALL

PROG:
SS 3 PSTG (77)

SS 4 /C?
USER:
ENERGY AND CONVERSION

PROG:
SS 4 PSTG (1205)

SS 5 /C?
USER:
1 OR 2
```

(CONTINUED NEXT PAGE)

Figure 3-5a. Sample Search 3 -- General Search

To obtain a feel for some of this literature, the first three abstracts are displayed (see Figs. 3-5b, 3-5c, 3-5d). All of the abstracts, if read carefully, can provide some quick input to your study without looking at the complete report, again emphasizing the utility of a well-written record.

4. Multiple Terms. For this final example, we investigate the problem of handling several terms -- all related to the effects of inflation on the automobile industry and on insurance companies. (See Fig. 3-6). We use the ABI/INFORM* data base. Various terms are se- and the Boolean combination is put into use.** The computer rapidly does its job of multiple manipulation and reduces the many to 5 particular citations; the first two are displayed. As in Example 3 above, a careful reading of the abstracts leads to extremely useful information; in some cases it obviates the need to look at full texts.

---

*American Business Institute Information

**The "W" in the parantheses in Fig. 3-6 assures that the terms to be picked up are adjacent.

```
PROG:
SS 5 PSTG (8911)

SS 6 /C?
USER:
3 AND 4 AND 5

PROG:
SS 6 PSTG (15)
SS 7 /C?
USER:
*PRINT 6 FULL

PROG:

-1-
AN  - AD-A034 871/4SL
TI  - International Symposium on Wind Energy Systems, Held at Cambridge
      Univ., 7-9 Sep 76
TNO - Conference rept.
AU  - Nunn, Robert H.
OS  - Office of Naval Research London (England)
PD  - 7 Dec 76, 28p
IS  - U7707
PR  - NTIS Prices: PC A03/MF A01
RN  - ONRL-C-31-76
CC  - 10A, 10B, 97D
IT  - *Energy conversion, Axes, Orientation(Direction),
      Configurations, Efficiency, Augmentation, Economic analysis,
      Fabrication, State of the art, Forecasting, Symposia, Planning,
      Great Britain
ST  - *Windmills, Wind turbines, Vertical axis turbines, Horizontal
      axis turbines, *Wind power generation, *Meetings, NTISDODXA
AB  - Vertical - and horizontal-axis systems were discussed both in
      theory and in practice. Applications ranged from wind farms each
      with hundreds of megawatt units to the use of Cretan windmills to
      provide water for cattle. Wind energy conversion units have been
      operated in several configurations and the theory of their
      performances is sufficiently advanced to allow design for
      fabrication. The trends are towards larger units for municipal
      power systems and smaller units for domestic use. In the former
      case, the behavior of large wind turbines operating in large
      arrays, and the output (with and without storage) of several such
      arrays when geographically dispersed, has yet to be well
      understood. The field has reached a level of maturity
      characterized by such factors as economics, environmental impact,
      and public acceptance.
```

(CONTINUED NEXT PAGE)

Figure 3-5b. Sample Search 3 -- General Search

-2-
AN - PB-256 198/3SL
TI - Wind Energy Conversion
TND - Progress rept. 15 Jul 75-15 Feb 76
AU - Miller, R. H.; Martinez-Sanchez, M.; Dugundji, J.; Larrabee, E.; Humes, T.
DS - Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.*Energy Research and Development Administration, Washington, D.C.*National Science Foundation, Washington, D.C. Research Applied to National Needs.
PD - 15 Feb 76; 183p
IS - U7623
PR - NTIS Prices: PC$7.50/MF$3.00
SPO - ERDA/NSF-00826/75-2; \NSF/RA-760160
RN - ASRL-TR-184-2
CG - NSF-AER75-00826
CC - 10B; 97D
IT - *Wind power generation; *Turbines; Windmills; Wind(Meteorology); Aerodynamic loads; Aeroelasticity; Wind tunnel models
ST - NTISNSFRA; NTISMITEL
AB - Testing of the wind tunnel model and aeroelastic analyses indicate the scope of the problem involved in selecting a suitable speed for a wind turbine. This report discusses the probability that at least for conventional rotor type wind turbines, a constant tip speed rather than a constant ratio of tip speed to wind speed is a more satisfactory design solution. The penalty involved in maintaining constant tip speed is investigated as part of the control strategy research (Task I) in order to determine whether control should be considered for a constant speed or for variable speed (constant tip speed ratio) wind turbine. As a result of experience with the aeroelastic analyses (Task 3), it was decided to concentrate on the constant speed configuration. Task 2 is concerned with the experimental and theoretical investigation of airloads in the presence of wind shear and gust.

(CONTINUED NEXT PAGE)

Figure 3-5c. Sample Search 3 -- General Search

-3-
AN - N76-21703/3BL
TI - Fabrication and Assembly of the Erda/NASA 100 Kilowatt Experimental Wind Turbine
AU - Puthoff, R. L.
CS - National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PD - Apr 76, 30p
IS - SI412
PR - NTIS Prices: PC$4.00/MF$2.25
RN - NASA-TM-X-3390, E-8663
CC - 10B, 97D
IT - *Windmills (Windpowered machines), *Windpowered generators, Energy policy, Experimental design, Clean energy, Design analysis, Electric generators, Energy conversion efficiency, Rotor blades (Turbomachinery)
ST - *Wind turbines, Electric power generation, NTISNASA
AB - As part of the Energy Research and Development Administration (ERDA) wind-energy program, NASA Lewis Research Center has designed and built an experimental 100-kW wind turbine. The two-bladed turbines drives a synchronous alternator that generates its maximum output of 100 kW of electrical power in a 29-km/hr (18-mph) wind. The design and assembly of the wind turbine were performed at Lewis from components that were procured from industry. The machine was installed atop the tower on September 3, 1975. (Author)

Figure 3-5d. Sample Search 3 -- General Search (Concluded)

```
        File15:ABI/INFORM 1976-12
        Set Items Description (+-OR;*-AND;--NOT)
        --- ----- -----------------------------
? SINFLATION;SAUTO(W)INDUSTRY;SAUTOMOBILE(W)INDUSTRY;SAUTOMOBILE?;SINSURANCE(W)
COMPANIES
          1  2546 INFLATION
          2    64 AUTO(W)INDUSTRY
          3    28 AUTOMOBILE(W)INDUSTRY
          4   366 AUTOMOBILE?
          5   583 INSURANCE(W)COMPANIES
? C1AND(2OR3OR4)AND5
          6     5 1AND(2OR3OR4)AND5
? T6/5/1-2
1
ID NO.- ADA096047039     047039
  CAR INSURANCE RATE HIKES MEAN LOWER AD BUDGETS
  ROZEN, LEAH
  ADVERTISING AGE V47 N34 AUG. 23, 1976 P12
  AS AUTOMOBILE-INSURANCE PREMIUMS ARE GOING UP, ADVERTISING BUDGETS
FOR CAR-INSURANCE COMPANIES ARE GOING DOWN. THE INSURANCE COMPANIES
HAVE SUFFERED HEAVY LOSSES, SO THEY ARE NOW IMPOSING RATE INCREASES.
RATES HAVE INCREASED IN RELATION TO SOARING COSTS FOR MEDICAL CARE,
AUTO REPAIRS, AND GENERAL INFLATION. STATE FARM AND ALLSTATE HAVE CUT
BACK THEIR ADVERTISING PROGRAMS, MOSTLY RESTRICTING THEM TO
CORPORATE-IMAGE ADS; IN SPITE OF THAT, THEY ARE ATTRACTING NEW
INSURANCE BUYERS AT A HIGH RATE, AND THEY ADMIT THAT THEY DO NOT NEED
TO ADVERTISE. SMALLER COMPANIES CANNOT AFFORD TO SIGN NEW CUSTOMERS
OR KEEP SOME OLD ONES. A FEW COMPANIES CONTINUE TO RUN SMALL
ADVERTISING CAMPAIGNS TO PROMOTE THEIR AUTO INSURANCE DIVISIONS.
SMALLER COMPANIES SAY THEY WILL BEGIN FULL ADVERTISING CAMPAIGNS AGAIN
WHEN THEY BEGIN TO REALIZE A PROFIT. LARGER COMPANIES SAY THEY WILL
STEP UP ADVERTISING WHEN THEIR COMPETITION BECOMES MORE AGGRESSIVE.

2
ID NO.- FBR096046874     046874
  THANK YOU, BELLE
  FORBES V118 N5 SEPT. 1, 1976 P69-71
  THINGS ARE LOOKING BETTER FOR INSURANCE COMPANIES - INFLATION IS
LESSENING, COURTS AND STATE LEGISLATURES ARE TALKING ABOUT PUTTING
LIMITS ON AWARDS, AND STATES ARE PAYING GREATER ATTENTION TO INSURER'S
APPEALS FOR HIGHER CEILINGS ON RATES. EVEN NATURE IS COOPERATING.
FOR EXAMPLE, HURRICANE BELLE, RAGING OUT OF THE ATLANTIC WITH 110-MILE
WINDS, WAS SUDDENLY REDUCED TO NO MORE THAN A BAD WINDSTORM WHEN IT
HIT LAND. MANY OF THE PAST TROUBLES OF INSURANCE COMPANIES WERE A
RESULT OF THEIR OWN DOING. THEY COULDN'T BE BLAMED FOR NOT FORESEEING
THE BULGING INFLATION OF THE 1970'S, BUT THEY WERE NOT ABOVE CRITICISM
FOR SO AGGRESSIVELY REACHING FOR NEW BUSINESS IN THE MIDST OF THE
SOARING INFLATION. MEANWHILE, THEY WERE FACED WITH A TWO-YEAR RISE IN
HOME REPAIR COSTS OF 23 PERCENT AND A 47 PERCENT RISE IN AUTOMOBILE
REPAIR PARTS. ALSO, MANY COMPANIES MADE BAD INVESTMENTS. THREATENING
TREND FOR THE PROPERTY AND CASUALTY FIELD IS THE INVASION BY THE GIANT
MUTUAL LIFE COMPANIES. CHARTS
```

Figure 3-6. Sample Search 4 -- Multiple-Term Search

Section 4

AFTER THE ABSTRACTS, WHAT NEXT?

In this section we carry the literature search process to its logical conclusion. What you have accessed so far, either manually or through the computer, is a set of records or abstracts. The next step is largely up to you. You must carefully review your research and select through a careful reading those which are relevant to your work. Choices must be made and they must be made with some care. In the same way, you must now further delimit the number of full texts you wish to go through. Again, as we said earlier, recognize that as volume mounts, it begins to approach a point where it will exceed your ability to make use of it.

A....what to select

With experience, you will learn how to effectively read abstracts* and make careful choices. Some suggestions follow; these are not all-inclusive, but can be used as guidelines:

1. If you are looking for background information, select:

   - review papers
   - annotated bibliographies
   - current literature
   - monographs
   - conference proceedings

*Note that as more and more people use computer systems as their primary research tool, abstract writing will become increasingly important. Review for a moment the variety of abstracts in the examples in Section 3and observe their varying quality, and hence, thier varying utility.

2. If you are looking for specific data, select:

   - the most recent article of a series (on the same topic) written by an author (authors update their own research and generally include the older data)
   - company or government reports, rather than journals (the former usually have the newer data)
   - articles from journals you know publish the type of information you seek
   - theses (they often deal with very specific problems)

Note that with a well-written abstract, it may simply be unnecessary to acquire the complete report or article. With your selected records you are now ready to access the hard copy/full text.

5....how to access hard copy/full text

Recognize at the outset that no single library -- your own or a neighboring one -- can possibly house everything. There are limits to acquisitions that one institution can make. Thus, you will have to ask the reference librarians at your library to help you track down journals, reports, articles, etc. not found in your own facility. Generally, there will be resource lists available to you indicating the holdings of neighboring libraries. You can then request your own librarian to acquire copies for you.

It must also be recognized that there are varying levels of access to full texts. One was just mentioned -- a copy for you to retain. Alternatively, you may consider purchase of a useful monograph, conference proceedings, subscription to a newly discovered and relevant journal, etc. Inter-library loans are also available. Thus, the complete article or report can be obtained for you to read, review, analyze, but returned to its owner.

On some data bases (and this keeps changing with time) you can directly order the record while using the computer terminal. The direct access will, over the years, probably become more prevalent.

Before going on, a word about types of hard copy might be in order. While a variety of formats exist, the two most popular are discussed here. You are used to thinking of paper copies as the basic literature format. While true and perhaps convenient, in the years to come as scientific literature expands, storage of this vast quantity of documents will become increasingly impossible. For this reason, many data banks are turning to microfiche for standardized text format. On a single fiche, multiple pages (up to 80 or 100, in some cases) can be recorded which obviously reduces the storage problem. On the other hand, as you will soon realize, fiche is simply not as convenient, a machine is required and notes must be taken separately. Given the alternatives, however, and on balance, we must learn to get along with this tool.

A final note of caution. One of the problems with on-line searching has been the failure to deliver hard copy full texts with a speed equal to that of the actual search. Lead time is required and careful planning for the use of the literature in your research is crucial. Even though your search may take only twenty minutes, you must allow considerably more time for actually seeing those documents relevant to your work.

Section 5

SOME FUTURES

As suggested earlier in this guide, the bibliographic files are not the sum total of advanced STI/SS. Indeed, many new information banks and sources are continually being established. While the basic purpose of this manual is to introduce you to these bibliographic or literature data bases -- aggregated and offered commercially by the Lockheed Corporation, Systems Development Corporation and Bibliographic Retrieval Services -- we would be remiss if we did not at least suggest some other STI/SS.

Numerical and graphic data are being collected by a group of Information Analysis Centers. These are funded by the United States Department of Defense, but are available to everyone. The major centers, and a brief description of them, are shown in Table 5-1. When reviewing this, note that these organizations can offer considerable help to you with specific problems. In addition, a variety of specialized private numerical sources are being established as well. For example, Man Labs, Inc. in Cambridge, Massachusetts has available a data base which provides thermochemical data,* as well as programs which allow manipulation of these data, for example, in the computation of phase diagrams.

This is really only the beginning. STI/SS developments in the coming quarter of the century will spring from trends already well

---

*It has been critically and favorably evaluated by the National Physical Laboratory in England.

established.* The foremost of these is technological, and represents combinations of biographic publishing (microfiche), computers, and telecommunications. Another major influence comes from the recognition that many societal problems have major technological components which require scientific and technological solutions. Finally, as you may have observed in your work, advanced STI/SS are cost effective and can significantly increase productivity on the job.

Some likely developments include:

Electronic Publication and Delivery. Documents will be obtained by mail, electronic delivery, etc. In all likelihood, microfiche will be the dominant form for publishing full texts of reports and articles.

Electronic-Based Informal Communication. Beyond the telephone, we can look to computer conferencing, linking individuals through terminals to computer-based switching arrangements. Sending, reading, answering can be accomplished at any time; access can be controlled. Messages may be announcements, new discoveries, paper publication, internal communications within research projects, etc.**

Integrated Publications. The primary journals and their accessing services will ultimately merge so that on-line appearance of an article will occur simultaneously with its publication. Some journal publishers will offer on-line access before the usual printed abstracts are available.

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*The succeeding discussion was abstracted from Burchinal, L.G., "The S&T Communication Enterprise in the United States," paper presented at the U.S./India Seminar on Scientific and Technical communication, Washington, D.C., October 13, 1976.

**The National Science Foundation is already supporting interesting trials in this regard.

Integrated Accessing Services. We will not be using the three major data base suppliers. New cooperative arrangements will evolve through electronic publishing and nationwide networks. Searching will be done with "normal" or "standard" language, eliminating or reducing the need for a trained intermediary.

Electronic Data Retrieval. The Information Analysis Centers (noted above) will go "on-line;" data will be stored in banks and will be continuously up-dated.

These are only some projections for the future. More are on the way. Recognize, however, that the first steps you will take in the use of computer-based bibliographic files will stand you in good stead in the years to come.

TABLE S-1

INFORMATION ANALYSIS CENTERS

Center Name & Location	Subjects Covered
Machinability Data Center 3980 Rosslyn Drive Cincinnati, Ohio 45209	Conventional machine practices, such feeds, speeds, depths of cuts, tool and fixture design, residual stresses Non-conventional material removal practices such as electrical discharge, electrochemistry, ultrasonic, laser beams Materials including difficult-to-machine materials such as high-strength steel, titanium, carbons, composites,polymers
Mechanical Properties Data Center Beltour Stulen, Inc. 13919 W. Bay Shore Drive Traverse City, Mich. 49684	Mechanical property tests, including: tensile, compression,shear, bearing, bending impact, fatigue, fracture toughness, stress corrosion, pressure vessel burst for steels, super alloys, nickel, titanium, magnesium, tentalium, tungsten, and their alloys
Metals & Cernamics Information Center Battelle-Columbus Laboratories 505 King Avenue Columbus, Ohio 43201	Design characteristics, processing, forming, joining, fabrication, test methods, applications, quality control, sources, suppliers and specifications for all metal, metal alloys, ceramic materials, composites Critical structural applications, stringent environments stressed
Nondestruction Testing Information Analysis Center Southwest Research Institute 8500 Culebra Road P.O. Drawer 28510 San Antonio, Texas 78284	All non-destructive testing and/or evaluation techniques and processes, involving energy-material interaction phenomena, economic aspects, trends, production, safety
Thermophysical & Electronic Properties Information Analysis Center CINDAS Purdue University 2595 Yaeger Road West Lafayette, Ind. 47906	Thermal conductivity, resistance, accommodation coefficient, viscosity, emissivity, specific heat Absorption coefficient, dielectric constant, effective mass, resistivity, Hall coefficient, energy levels, electron emission properties, magnetomechanical properties, luminescence properties for elements, inorganics, alloys, intermetallics, glass, ceramics

TABLE 5-1 (CONT.)

Center Name & Location	Subjects Covered
Chemical Propulsion Information Agency The Johns Hopkins University Applied Physics Laboratory Johns Hopkins Road Laurel, Maryland 20810	Solid, liquid, hybrid, air-breathing propulsion, fuels, components, propellants: chemical synthesis, combustion and plume phenomena, physical, chemical, mechanical properties of fuels, performance, test techniques, design criteria, safety (also includes classified information)
Infrared Information and Analysis Center Environmental Research Institute of Michigan Box 618 Ann Arbor, Michigan 48107	Infrared sources, characteristic radiation, optical properties, techniques, lasers, masers (also includes classified information)
Reliability Analysis Center Rome Air Development Center RBRAC Griffiss Air Force Base, New York 13441	Microcircuits, hubrid circuits, thermal thick films, semi-conductors, diodes, modules, etc. Reliability, failure mode and mechanisms, R&D studies, process control, qualification, testing, problem investigation, plans, procedures

Other Centers of Interest

Coastal Engineering Analysis Center Coastal Engineering Research Center Kingman Building Fort Belvoir, Virginia 22060	Concrete Technology Information Analysis Center Army Engineers Waterway Experiment Station P.O. Box 631 Vicksburg, Mississippi 39180
Hydraulic Engineering Information Analysis Center Army Engineers Waterway Experiment Station P.O. Box 631 Vicksburg, Mississippi 39180	Pavement & Soils Trafficability Analysis Center Army Engineers Waterway Experiment Station P.O. Box 631 Vicksburg, Mississippi 39180
Soil Mechanics Information Analysis Center Army Engineers Waterway Experiment Station P.O. Box 631 Vicksburg, Mississippi 39180	Platics Technical Evaluation Center Picatinny Arsenal Dover, New Jersey 07801

TABLE 5-1 (CONT.)

Other Centers of Interest

Cold Regions Science & Technology
Information Analysis Center
Cold Regions Research and
Engineering Laboratory
Hanover, New Hampshire 03755

Tactical Technology Center
Battelle-Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

Shock & Vibration Information Center
Naval Research Laboratory
Code 6020
Washington, D.C. 20390

Department of Defense Nuclear
Information & Analysis Center
General Electric-TEMPO
816 State Street
P.O. Drawer QQ
Santa Barbara, California 93102

NYIT/TECHSEARCH

USER PROFILE

NAME: _____ NYIT DEPT.(if any): _____

ADDRESS: _____

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THIS FORM MUST BE COMPLETED PRIOR TO USING "TECHSEARCH." A CAREFUL REVIEW OF THIS FORM WITH YOUR ADVISOR WILL INCREASE THE EFFICIENCY OF THE TECHSEARCH PROCESS FOR YOU.

1. Please give a title to your problem: _____

_____

2. In your own words, please give a narrative description of your problem. Be as specific as possible; define phrases with special meanings. Append a list of synonyms, closely related phrases and alternate spellings for the important descriptive words in your narrative. Use scientific and technical terms as well as common vocabulary. Be sure to indicate any models, end uses, or applications which might help you in your research. When you have finished your description, review it and underline those words, phrases, or key elements most essential to your search. (If any of the key words are newly coined or newly defined, redefine them in standard terms.)

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3. From the manual search you carried out, please list the terms and key words you found particularly helpful. Also please list complete citations to two or three of the more useful articles you uncovered.

_____

_____

_____

4. If you expect your problem to be covered (or not covered) in a particular type of publication, indicate sources to be searched by checking appropriate space(s):

Journal ____ Technical Report ____ Monograph ____

Symposium ____ Conference Proceedings ____ Patent ____

Dissertation ____ State-of-the-Art Review ____ Other ____

5. Please state any topics, applications, views or approaches to your specific problem which are of no interest to you so that these can be excluded from the search and not retrieved. (These exclusions might arise because you are not interested in a particular avenue of approach to the research, or because you are fully aware of such an approach but do not need it for your work.)

_____

_____

_____

_____

6. If known, please list two or three important authors and/or organizations which are working or publishing in your field of interest. (Full names are most helpful). Also indicate if you wish to exclude any authors or organizations because you are not interested in their work or are already familiar with their publications.

_____

_____

_____

_____

7. If known, please list two or three important journals in your field of interest:

_____ _____ _____

Do you wish to retrieve references only from these journals?

Yes ____ No ____

Indicate journals you do not want searched, even though in your field of interest:

_____ _____ _____

8. If you wish to also retrieve documents not written in English, please indicate below what other languages are acceptable:

_____ _____ _____

9. If you wish to limit your search to a particular time span, indicate years below:

_____

10. Please indicate below by checking appropriate space, the number of references you wish to retrieve:

1-10 ____ 11-20 ____ 21-50 ____ 51-100 ____ Over 100 ____

11. If you are familiar with computerized retrieval, please indicate data bases to be searched. (A list of data bases is attached.)

_____ _____

_____ _____

_____ _____

DATA BASES AVAILABLE FOR TECHSEARCH

ABI/INFORM
AGRICOLA
AIM/ARM
API
ASI
BIOSIS PREVIEWS
CASIA
CDI
CEC
CHEMABS
CHEMCON
CHEMNAME
CIS
CLAIMS/CHEM
CLAIMS/GEM
COMPENDEX (EI)
CRECORD
DISSERTATIONS
DNI
EIS
ENERGYLINE
ENVIROLINE
ERIC RIE,CIJE
FDN DIRECTORY
FDN GRANTS
GEOREF
INSPEC-ELEC/COMP
INSPEC-PHYSICS
ISMEC
LIBCON
METADEX
METEOR/GEO ABS
NTIS
OCEANIC ABS
PAPERCHEM
P/E NEWS
POLLUTION
PSYCH ABS
PTS CIN
PTS CMA & EMA
PTS DOM STAT
PTS F&S
PTS FRN STAT
PTS WEEKLY
SCISEARCH
SOCIOL ABS
SOC SCISEARCH
SSIE
TULSA
WORLD ALUM ABS

Appendix B

MANUAL INDICES

NAME	DESCRIPTION	FIELDS COVERED
Applied Science and Technology Index	Cumulative subject index to English language periodicals	Aeronautics & Space Science Automation, Chemistry, Construction, Earth Sciences Electricity & Electronics, Industrial & Mechanical Arts Materials, Mathematics, Metallurgy, Physics, Telecommunication, Transportation,
Business Periodicals Index	Cumulative index to English language periodicals with subject entries to articles in business periodicals	Accounting, Advertising & Public Relations, Banking, Building & Buildings, Chemicals, Communications, Computer Technology & Applications, Drugs & Cosmetics, Economics, Finance & Investments, Industrial Relations, Insurance, International Business, Management & Personnel Administration, Marketing, Occupational Helath & Safety, Paper & Pulp, Petroleum & Gas, Printing, Publishing, Real Estate, Transportation
Education Index	Cumulative subject index to educational materials. (Primarily a periodical index, but includes proceedings, yearbooks, bulletins, monographs and U.S. Gov't printed materials)	Administration, Pre-school, Elementary, Secondary, Higher and Adult Education, Teacher Education, Counseling & Guidance, Curriculum & Curriculum Materials. Also: Arts, Applied Science & Technology, Audio-Visual Education, Business Education, Comparative & International Education, Exceptional Children, Special Education, Health & Physical Education, Languages & Linguistics, Psychology & Mental Health, Religious Education, Social Studies

MANUAL INDICES (CONT.)

NAME	DESCRIPTION	FIELDS COVERED
Engineering Index	Reference guide to literature by and for engineers; includes abstracts to be found under main subject headings (and subheadings)	All disciplines of Engineering, Technology, and Applied Science Transdisciplinary functions of engineering involving Research, Development & Testing, Design & Systems Engineering, Construction & Maintenance, Production, Sales & Marketing, Management, Consulting & Education
Humanities Index	Guide with author and subject entries to periodical articles; includes listing (by author) of citations to book reviews	Archaeology & Classical Studies, Area Studies, Folklore, History, Language and Literature, Literary & Political Criticism, Performing Arts, Philosophy, Religion, Theology
Index to Legal Periodicals	Index to legal periodicals of U.S., Great Britain, Canada, N.Z., Australia & Ireland Articles are indexed under subject and author.	Administrative Agencies, Civil Rights, Courts, Criminology, Government, Human Rights, Jurisprudence, Law, Legislation, Penology, Privileges, Probation, Securities, Trials
Public Affairs Information Service Bulletin	Lists books, pamphlets, periodical articles, government documents and other useful material	Economics, Public Affairs
Social Sciences Index	Author and subject guide to periodical articles; includes listing (by author) of citations to book reviews	Anthropology, Area Studies, Economics, Environmental Science, Geography, Law & Criminology, Medical Sciences, Political Science, Psychology, Public Administration, Sociology

Appendix C

COMPUTERIZED DATA BASES

In this appendix, the current data bases available through the NYIT/TECHSEARCH system are displayed. Included therein are the scope, time periods covered, types of documents, thesauruses, search aids*, and search capabilities. This information is presented in Table C-1.

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*These handy aids, available in the library, permit you to utilize the language and descriptors appropriate to the data base in use.

TABLE C-1

Computerized Data Bases (as of January 1977)

NAME	SCOPE	TIME PERIOD	[a] TYPES OF DOCUMENTS	[b] THESAURUS	[c] SEARCH CAPABILITIES
Abstracted Business Information (ABI/INFORM)	Management, Administration, Finance	1971 +	1	--	1,2,3
Abstracts of Instructional and Research Material (AIM/ARM)	Instructional and research materials for vocational and technical education	1966 +	1,2	1	2,3,4,5
Agricola-CAIN	Agriculture file of National Agriculture Library (includes data base of Food and Nutrition Information) Center	1970 +	1,2,3,4	--	1,2,3,4
America: History and Life (AHL)	American and Canadian History	1964 +	1	--	2,3,4,5
American Statistics Index (ASI)	Guide and index to statistical publications of U.S.government	Current	7	21	3,4
Biosis Previews	Biological Abstracts, Bioresearch Index	1972 +	1,2,3,4	3,4,5	2,3,5
Chemical Abstract Subject Index Alert (CASIA)	Subject index, headings and registry numbers for CA condensates	--	7	--	2,5
Chemical Abstract Condensates	Chemical Abstract Service	1972 +	1,2	--	1,2,3

TABLE C-1 (CONT.)

NAME	SCOPE	TIME PERIOD	[a] TYPES OF DOCUMENTS	[b] THESAURUS	[c] SEARCH CAPABILITIES
Chemical Abstract Chemical Name Dictionary (CHEMNAME)	CA Registry Number, index names, molecular formulas, synonyms	Current	7	--	2,5
Compendex	Engineering reports, journals, documents from Engineering Index	1970 +	1,2,3	6,7,8,9,10	2,3,4,5
Comprehensive Dissertation Abstracts	All published dissertations	1861 +	7	--	2,3,4,5
Congressional Information Service (CIS)	Congressional publications	Current	7	22	3,4
Educational Resources Information Center (ERIC)	Complete file of ERIC from NIE and other sources; from Resources in Education and Current Index to Journals in Education	1966 +	1,2	1	1,2,3,4
Enviroline	Environmental books, films, Federal Register data	1971 +	1,3,7	--	2,3,4,5
Exceptional Child Education Abstracts	Information produced by Council for Exceptional Children	1966 +	1,2	2	1,2,3,4
Foundation Directory	Descriptions of Foundations	Current	7	18	2,3,5
Foundation Grant Index	Grant records of American philanthropic foundations	1973 +	7	18	2,3,5

TABLE C-1 (CONT.)

NAME	SCOPE	TIME PERIOD	[a] TYPES OF DOCUMENTS	[b] THESAURUS	[c] SEARCH CAPABILITIES
Historical Abstracts	World history (excluding American and Canadian)	1974 +	1	--	2,3,4,5
INSPEC-Electronics Computer	Electronics, Computers, Controls Abstracts from IEEE	1969 +	1	12	2,3,4,5
INSPEC-Physics	Physics abstracts from Institute of Electrical Engineers	1969 +	1	12	2,3,4,5
ISMEC	Mechanical engineering and engineering management	1973 +	1,2	--	2,3,4,5
Metals Abstracts and Alloys Index (METADEX)	Worldwide metallurgical literature	1966 +	1,2	20	2,3,4,5
Meteorological Abstracts	Meteorological and astrophysical research	1972 +	1,2	--	2,3,4,5
National Technical Information Service	Primary source of U.S. government-sponsored research, development and engineering reports for NASA, AEC, DOD, HEW, etc.	1964 +	2	6,7,8,9	1,2
Oceanic Abstracts	Worldwide technical information on seas of the world	1964 +	1,2,3,4	19	2,3,4,5

TABLE C-1 (CONT.)

NAME	SCOPE	TIME PERIOD	[a] TYPES OF DOCUMENTS	[b] THESAURUS	[c] SEARCH CAPABILITIES
Pollution Abstracts	Pollution literature from Pollution Abstracts	1971 +	1,2	19	3,4,5
Psychological Abstracts	Journals on psychology	1967 +	1	11	2,3,4,5
PTS Chemical Equipment Market Abstracts ((CMA & EMA)	Chemical Process, Electronic, Data Processing Industries	1972 +	5	13,14,15	2,5
PTS Chemical Industry Notes (CIN)	Business-oriented events in chemical industry	1974 +	1,5,6	13,14,15	2,3,4,5
PTS CMA-EMA & FLS Weekly	Temporary file for CMA-EMA & FLS	--	5	13,14,15	2,3,5
PTS Domestic Statistics	Series of forecasts, historical data, economics, demographics, products, wages, prices, SMSA's,etc.	1971 +	7	13,14,15, 16,17	--
PTS Economics Information System (EIS)	Records for U.S.firms: geographic region, sales, market share, product, no. of employees	Current	7	--	3
PTS F&S INDEXES	Products, company and industry information	1972 +	5,6	13,14,15	2,3,4,5
PTS Industrial Statistics	Similar to PTS Domestic Statistics	1971 +	7	13,14,15, 16,17	2,3,5
Science Citation Index (Sci-Search)	Science citations in physics, biology,medical	1974 +	1,3	--	2,3,5

TABLE C-1 (CONT.)

NAME	SCOPE	TIME PERIOD	[a] TYPES OF DOCUMENTS	[b] THESAURUS	[c] SEARCH CAPABILITIES
Smithsonian Scientific Information Exchange	Planned, on-going recent research projects from federal, state, local governments, associations, foundations, universities	Current	7	23,24	3,4
Sociological Abstracts	Worldwide sociological abstracts	1963 +	1,2	--	2,3,4,5
Social Scisearch	Social and behavioral sciences	1972 +	1,3	--	2,3,5
World Aluminum Abstracts	World aluminum literature	1968 +	1,2,7	--	2,3,5

[a] TYPE OF DOCUMENT

1 = Journals
2 = Reports
3 = Books
4 = Conference Proceedings
5 = Product Information
6 = Company Reports
7 = Special Reports

[c] SEARCH CAPABILITIES

1 = Primary Index
2 = Full-Text Searches
3 = Single-Word Terms
4 = Multi-Word Terms
5 = Basic Index

[b] THESAURUS

1 = Thesaurus of ERIC Descriptors
2 = Thesaurus for Exceptional Child Education
3 = Subject Guide to Cross Index
4 = Cross Code
5 = Biosystematic Code
6 = Subject Headings Used by USAEC: INS Thesaurus
7 = Thesaurus of DDC Descriptors
8 = NASA Thesaurus
9 = Thesaurus of Engineering and Scientific Terms
10 = Subject Headings for Engineering
11 = Thesaurus of Psychological Index Terms
12 = INSPEC Thesaurus
13 = Predicasts SIC Product Codes
14 = Predicasts Geographic Codes
15 = Predicasts Event Codes
16 = Predicasts Measure Codes
17 = Quick Codes for Composites of Files
18 = Foundation Directory
19 = Keyword Master List
20 = Thesaurus of Metallurgical Terms
21 = ASI Annual
22 = CIS Annual
23 = Subject Terms and Synonyms List of SSIE
24 = Guide to SSIE Subject Indexes and Vocabulary

APPENDIX D

ELEMENTS OF A COMPLETE RECORD

AN - PB-256 198/3SL *(accession number)*
TI - Wind Energy Conversion *(title)*
TNO - Progress rept. 15 Jul 75-15 Feb 76 *(type of report)*
AU - Miller, R. H.; Martinez-Sanchez, M.; Dugundji, J.; Larrabee, E.; Humes, T. *(authors)*
OS - Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.;Energy Research and Development Administration, Washington, D.C.;National Science Foundation, Washington, D.C. Research Applied to National Needs. *(organization & sponsor)*
PD - 15 Feb 76; 183p *(report date & length)*
IS - U7623 *(identifier source)*
PR - NTIS Prices: PC$7.50/MF$3.00 *(prices for paper copy & microfiche)*
SPO - ERDA/NSF-00826/75-2, \NSF/RA-760160 *(sponsor and number)*
RN - ASRL-TR-184-2 *(report number)*
CG - NSF-AER75-00826 *(contract or grant number)*
CC - 10B; 97D *(corporate code)*
IT - *Wind power generation; *Turbines; Windmills; Wind(Meteorology); Aerodynamic loads; Aeroelasticity; Wind tunnel models *(descriptors)*
ST - NTISNSFRA; NTISMITEL *(sponsoring agency identifier)*
AB - Testing of the wind tunnel model and aeroelastic analyses indicate the scope of the problem involved in selecting a suitable speed for a wind turbine. This report discusses the probability that at least for conventional rotor type wind turbines, a constant tip speed rather than a constant ratio of tip speed to wind speed is a more satisfactory design solution. The penalty involved in maintaining constant tip speed is investigated as part of the control strategy research (Task I) in order to determine whether control should be considered for a constant speed or for variable speed (constant tip speed ratio) wind turbine. As a result of experience with the aeroelastic analyses (Task 3), it was decided to concentrate on the constant speed configuration. Task 2 is concerned with the experimental and theoretical investigation of airloads in the presence of wind shear and gust. *(abstract)*